AutoWARN
The Automated Weather Warning System in NinJo

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Content

♦ Introduction and Overview

♦ Automatic Warning Process

♦ Radar Products

♦ Statistical Products and COSMO-DE Interpretation
AutoWARN is part of the DWD strategy 2006-2015 (Headwords: Centralization and Automation).

Project goals:

1. Improvement of methods and products serving as a basis for the prediction of hazardous weather events

2. Integration of products in an automated warning process with manual monitoring and decision capabilities by the forecaster
Project AutoWARN

Project Structure

SP1: Automatic Warning Process

M1: AutoMON
Extensions in NinJo
(ASG: AutoWARN Status Generator)

M2: EPM
Extensions in NinJo
(ASE: AutoWARN Status Editor)

SP2: Radar Products

M1: Quality Assurance of 3D Volume Radar Data

M2: Mesocyclone Detection and other Algorithms

M3: Integration in NinJo

SP3: Statistical Products

M1: WarnMOS on ECMWF-Basis

M2: CellMOS and Integration in WarnMOS

SP4: COSMO-DE Interpretation

M1: COSMO-DE Warning Events
# Project AutoWARN

## Time Planning

<table>
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<th>Activity</th>
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## Resources

- **2006**
  - 1 Computer Scientist – ASG
  - 1 Computer Scientist – AutoMON Data
  - 1 Computer Scientist – AutoMON Extensions

- **2007**
  - 1 Scientist – DWD Volume Data
  - 1 Scientist – Quality Assurance
  - 1 Computer Scientist – Radar Data Algorithms

- **2008**
  - 1 Scientist – DWD Volume Data

- **2009**
  - Development (external)

**Subproject leader (Dr. Peyinghaus)**

**Subproject leader (Heizenreder)**

**Development**

**Project leader (Dr. Reichert)**

**Scientific Overall Concept**

Bernhard Reichert, DWD
Content

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♦ Statistical Products and COSMO-DE Interpretation
Automatic Warning Process: Goals

- **Exploitation and combination of various data sources**
  - Arbitrary data combinations (Probability information (WarnMOS), Nowcasting, Observations, Model runs, etc.)
  - Definition and monitoring of threshold values

- **Generation of a forecast-time dependant automatic warning status**
  - Ensures that required warnings cannot be overlooked
  - Supports the warning service

- **Permanent updates of the warning status**

- **Permanent manual control by the forecaster**
  - Manual modification if necessary

- **Export of generated warning status to external system (outside of project AutoWARN)**
  - External generation of text and graphical products considering client demands
Project AutoWARN

Automatic Warning Process: Overview

- WarnMOS
- COSMO-DE
- Observations
- Lightning, BlitzMOS
- CellMOS / KONRAD
- Radar / RADVOR-OP
- MOSMIX
- PEPS

AutoMON
- Automatic Monitoring
- Warning Events

ASG
- AutoWARN Status Generator
- Automatic Warning Status Proposal

ASE
- AutoWARN Status Editor
- Manually Modified Warning Status, Export

External Product Generation and distribution

Within AutoWARN Project

Outside of AutoWARN
Project AutoWARN

Generation of a Warning Status Proposal 1/3

AutoMON: List of Basic Criteria (>100)

- FX63 = 43%
- RA25 = 57%
- SN10 = 33%
- TS = 55%
- TSX = 55%
- (…)

- FX63 = 34%
- RA25 = 43%
- TS = 66%
- (…)

- RA25 = 60%
- SN10 = 72%
- (…)

- FX = 120 km/h
- RR1 = 25 mm
- WW = 95
- (…)

- RR1 = 25 mm
- (…)

- n = 5 (Strokes)
- P(n=1) = 30%
- (…)

- categ = 2
### AutoMON: List of Basic Criteria (>100)
- FX63 = 43%
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- n = 5 (Strokes)
- P(n=1) = 30%
- (...)  
- categ = 2

### AutoMON: Spatiotemp. Combination

### AutoMON: Combined Warning Criteria
- Wind Gusts
- Hazardous Storm
- Heavy Rain
- Continuous Heavy Rain
- Thunderstorm with Heavy rain and Hail
- (...)  

### ASG: Spatiotemporal Homogenization
ASG: Force Consistency

ASE: Manual Modification of Warning Status Units with permanent consistency check

Consistency Check

Export Warning Status Proposal to AG PVW
AutoWARN generates

- categorical warn status data (will be extended to probabilities in a project starting in 2009)
  - For 27 DWD warning events plus approx. 20 combined warning criteria
  - on a polygon basis (“warning status units” in space and time)
  - vertical categorization to the DWD altitudes (e.g. 0-200m, 400-1000m, 1000-2500m)
  - hourly forecasted 0…72 hours

AutoWARN warning status
(all warning criteria, 0...72 hours)
AutoWARN does not generate direct warning products for clients

- AutoWARN only generates automatic warning status proposals revised by the forecaster, only the following external module (PVW) generates warning products.

AutoWARN cannot create “perfect” warning status proposals for all warning events automatically

- an automatic warning status proposal cannot be better than the input products (WarnMOS, COSMO-DE model, etc.)

- some warning events like fog or locally clear ice need the intervention of the forecaster, who is part of the AutoWARN concept.
Project AutoWARN

Automatic Warning Process: Component AutoMON in NinJo

Warning Indicators showing status since last confirmation

Warning Events
Automatic Warning Process: Component AutoMON in NinJo
AutoMON Extensions

- Include far more input data (areal probabilities from WarnMOS and COSMO-DE model, other probabilistic products, Grid-Data, more Radar-Data, more nowcasting products)
- Allow forecast-time dependant configuration of probability data for the generation of warning categories
- Allow full spatio-temporal combination of data for warning events
- Improve stability and reliability of AutoMON for AutoWARN
Requirements

- Presentation of warning status proposals by ASG (AutoMON Status Generator)
- Editing the future warning status based on warning status proposals

Result

- New warning status for subsequent generation of warning products and verification outside of AutoWARN
AutoWARN Status Editor (ASE) - GUI Creation and Visualization of Warning Status

- Creation and visualization of warning areas
- Visualization of elevation and time
AutoWARN Status Editor (ASE): GUI Warning Status Properties

- **Current warning status**
- **Selection of warning events**
- **Elevation interval**
- **Time interval**
- **Warning event type**
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Radar Products: Goals

- **Exploitation of DWD Doppler data, Quality Assurance of 3D-Volume Scans**

- **Implementation of Mesocyclone Detection and other Radar Algorithms**
  - Improved algorithms for mesocyclone-, gust- and downburst-detection
  - Tornado-Identification algorithms
  - Exploitation of Doppler data
  - Benefit from Canadian Radar know-how

- **Visualization in NinJo**

- **Integration of New Products in NinJo and Automatic Warning Process**
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Statistische Produkte und COSMO-DE Interpretation: Ziele

- **Extension of WarnMOS (Areal Probability Data for Warning Events)**
  - Implementation of WarnMOS-MIX using GME und ECMWF-Model

- **Implementation of a new Storm Cell Tracking System CellMOS**
  - Using GME-Model, Radar Composite, Radar-Analysis (KONRAD), Lightning Data
  - Cell Analysis using Radar Data (KONRAD) and optimized statistical tracking approach (MOS-System)

- **COSMO-DE Interpretation**
  - Generation of Probability Data for 23 Warning Events from High Resolution Limited-Area Model COSMO-DE (2.8 km resolution)

- **Integration of New Products in NinJo and Automatic Warning Process**
Typical CellMOS-Output

- **O**: Forecasted Cell Track
- **O**: Cell at Issue-Time Point (Analysis)
- **O**: Observed Cell Track
- **Green Area**: Probability > 30% that point in this area is hit by cell
Summary and Outlook

- **Goals of AutoWARN:**
  1. Improvement of methods and products serving as a basis for the prediction of hazardous weather events
  2. Integration of products in an automated warning process with manual monitoring and decision capabilities by the forecaster

- Pre-operational test phase for AutoWARN is planned for spring 2009

- AutoWARN will in follow-up projects as of 2009 be extended:
  1. Optimize system by improving warning parameters and homogenization process
  2. Process probability-based information from ensemble model runs, and other MOS-based probability information